GREAT Spectral Resolution

SOFIA

Wavelength range: **60 - 200 µm**
(~2 - 5 THz)

Three bandpasses:

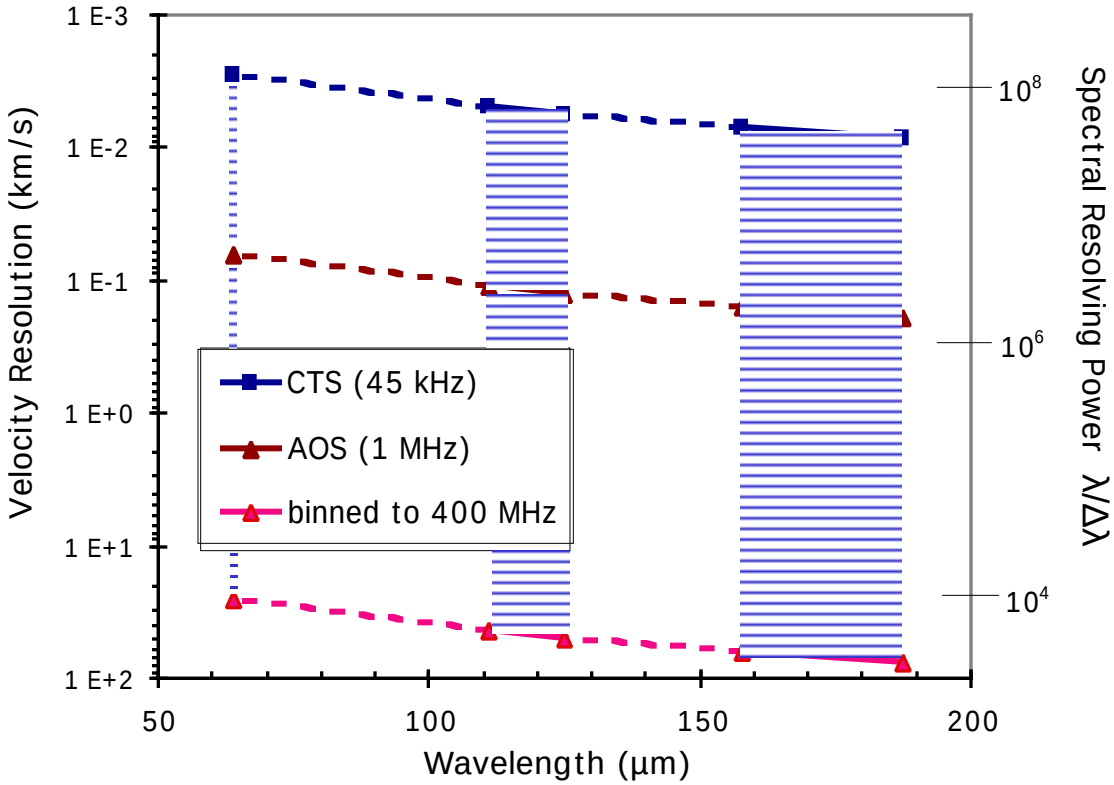
1.6 - 1.9 THz (158 - 187 µm)
2.4 - 2.7 THz (110 - 125 µm)
~ 4.7 THz (~ 63 µm)

Two of the three bandpasses will be installed for a flight. Frequency change within a bandpass requires about 10 minutes. Frequency setting accuracy is better than 1 kHz.

The spectral resolution plotted corresponds to the FWHM of the instrument line spread function for a monochromatic line from a point source.

Two backend options (AOS, CTS) are available:

backend	R	instantaneous bandwidth
AOS	~10^6	4 GHz
CTS	~10^8	180 MHz



Upper curves are maximum resolutions; lowest curve is AOS binned to a minimal resolution of 400 MHz (~30 to 70 km/s). Shading indicates the effectively continuous range of resolution available between the curves.

Sensitivity is shown for 1, 10 and 100 km/sec wide emission lines, observed with resolutions indicated by q = line width / resolution. The red curve is for a 1 km/s line observed at the full 1 MHz resolution of the AOS.

MDLF is the "minimum detectable line flux", 4σ in 15 minutes (900^s).

MDLF scales as (S/N) /√ t
where t = net integration time

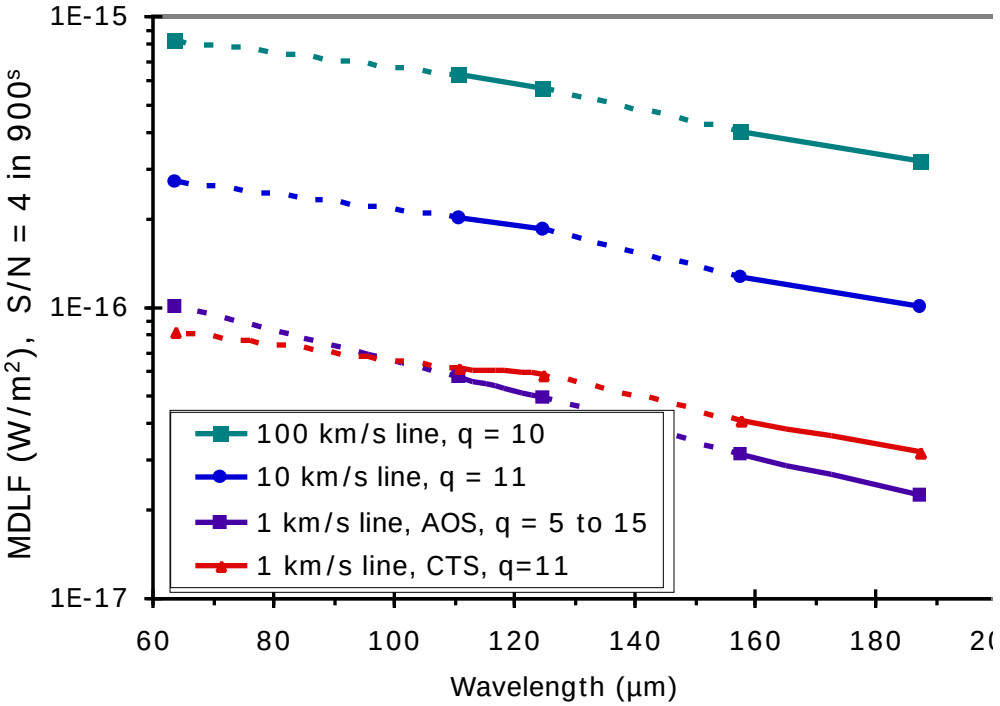
For a resolved line:

$$\text{MDLF} \quad \left(\frac{S}{N}\right)\frac{\sqrt{\text{line width}}}{\sqrt{t}}$$

In bright continuum sources, line measurements may take longer to reach the same S/N.

Atmospheric transmission may preclude measurements at some wavelengths and reduce sensitivity at others.

Calibration and setup overhead is very roughly 20%.

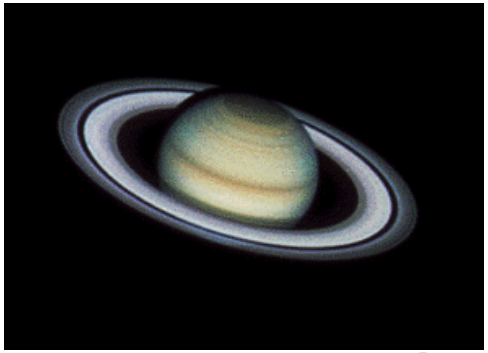


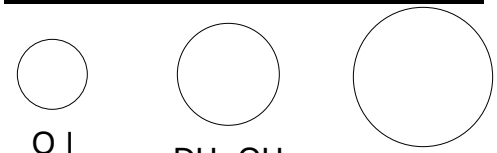
Estimated system noise temperature includes receiver noise and estimated telescope & sky emission. The following table gives antenna temperature values corresponding to the example line widths:

Line width	T_a*	Integrated line flux
100 km/s	0.12 K	12 K – km/s
10 km/s	0.4 K	4.0 K – km/s
1 km/s (AOS)	0.4 K	0.4 K – km/s
1 km/s (CTS)	1.6 K	1.6 K – km/s

Beam size shown is the FWHM for nominal operating conditions.

The approximate beam sizes in the three GREAT passbands are shown below scaled to an image of Saturn.

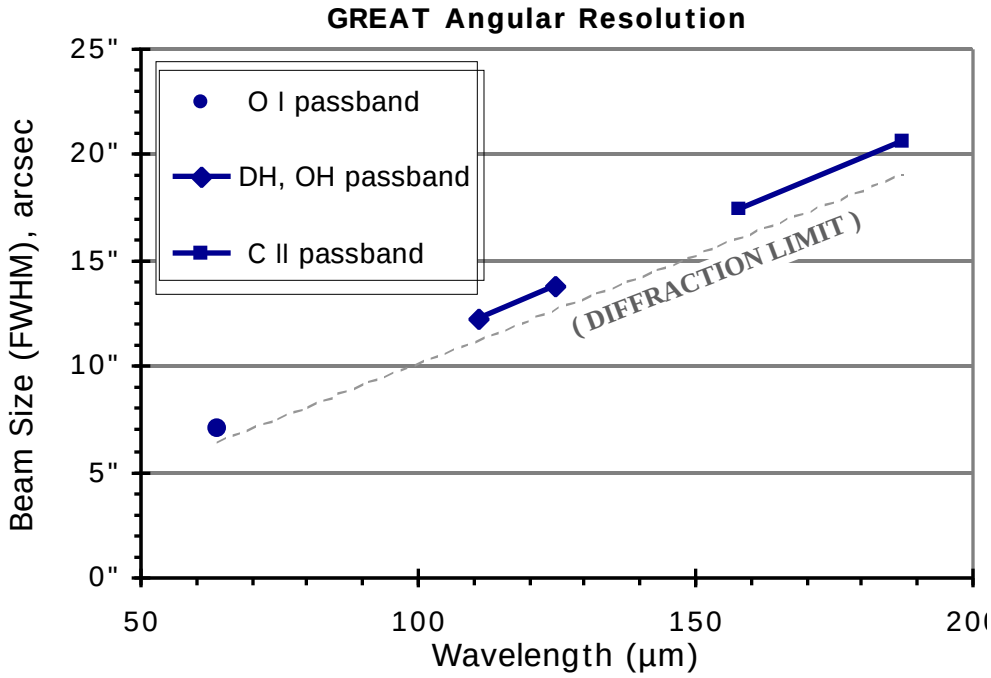




O I beam λ 63 µm

DH, OH beam λ ~120 µm

C II beam λ ~180 µm



SOFIA and all first light focal-plane instruments are now in development. All sensitivity and resolution data are preliminary, and based on anticipated performance of the observatory and the instruments. Actual performance of the SOFIA telescope and instrument combination will be established after flight operations begin. Telescope performance is expected to be upgraded during the first two years, and instrument performance may be upgraded, or additional modes or capabilities may be added.

PERFORMANCE ESTIMATES GIVEN HERE ARE BASED ON DATA SUPPLIED BY THE INSTRUMENT TEAMS.
A POINT OF CONTACT FOR EACH INSTRUMENT IS PROVIDED.